# A Range Telescope for Proton Therapy

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## Summary

There is the need for cheap technology to perform fast and precise measurements of the range of clinical proton beams for quality assurance. We are developing a range telescope[5] which is based on a plastic scintillator[2] and an image sensor[4]. The first beam test of the detector shows very promising results. Future challenges include radiation hardness tests of the scintillator and the development of a read-out system.

## Introduction & Theory

Knowing the range of a proton beam is crucial for an accurate treatment because of the steep fall-off at the end of a Bragg curve[1]. Proton beam range measurements are carried out as part of the daily **quality assurance** in proton therapy. Detectors currently available are either slow or expensive.

We are developing a fast and cheap detector using a segmented plastic scintillator[2] called "**range telescope[5]**" (figure 1). A proton beam produces scintillation light when it deposits energy in the scintillator[2] sheets. From the quenched[3] light output we can reconstruct the proton beam range (figure 2).

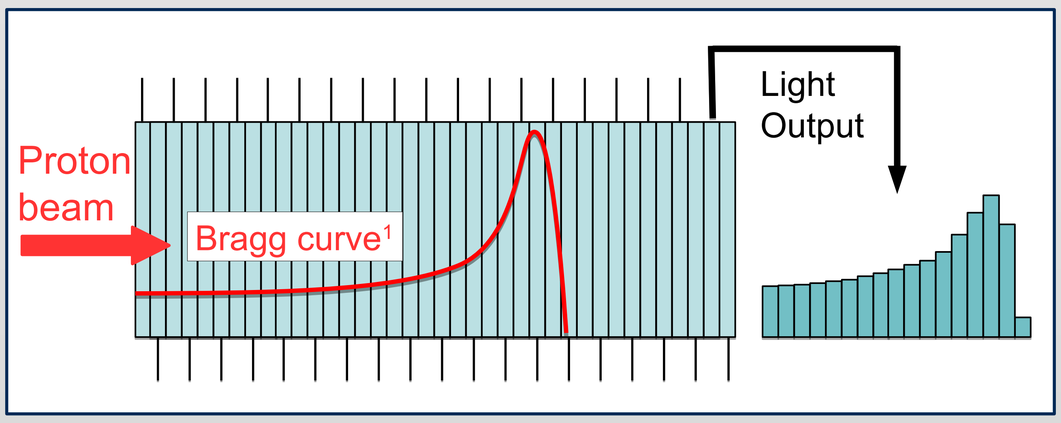


Figure 1: Principle of a range telescope[5].

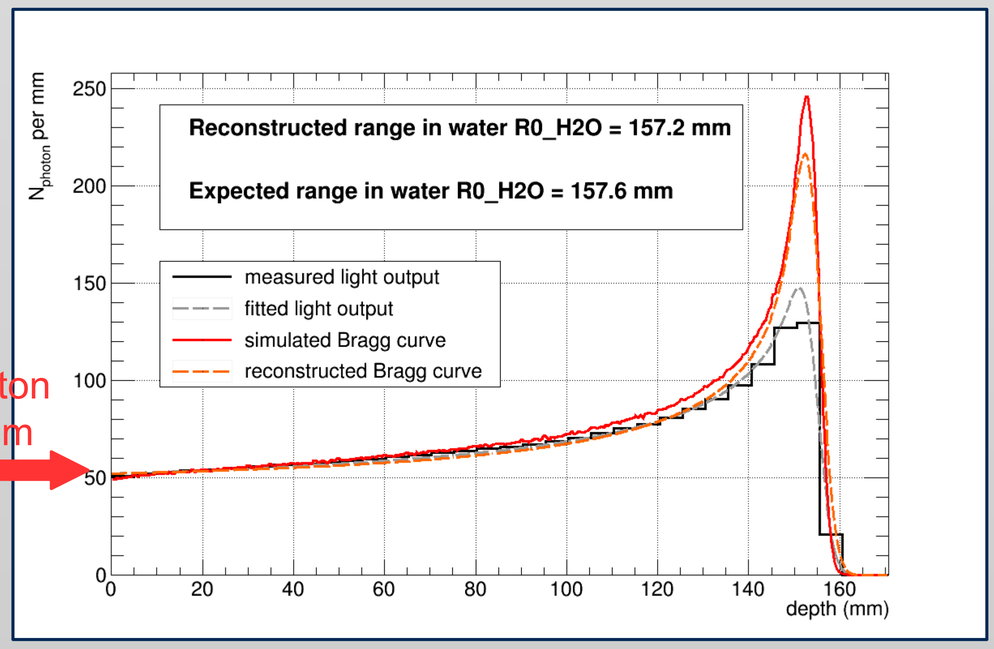


Figure 2: Reconstruction of a Bragg curve[1] from the quenched[3] light output of a range telescope[5] (simulation).

## Beam Test

A proof-of-principle beam test was performed in September 2017. The prototype is based on a CMOS sensor[4] and three plastic scintillator[2] sheets that are wrapped in reflective foil (figure 3). Figure 4 shows an image of the light output from which we can reconstruct the proton beam range.

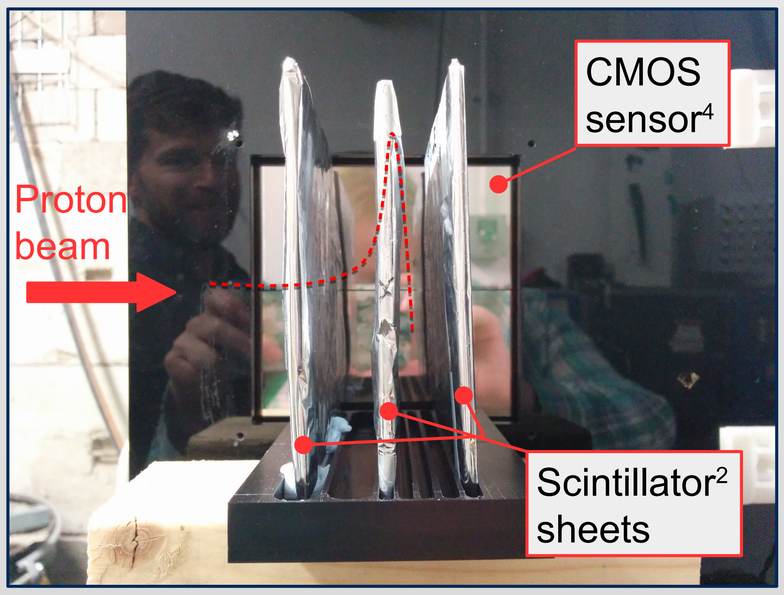


Figure 3: Test of the prototype detector.

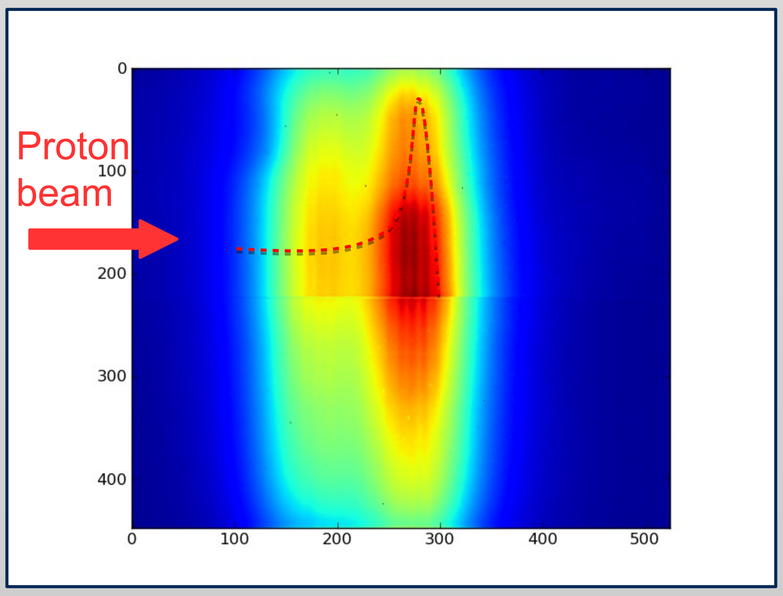


Figure 4: Image of Light output taken by the CMOS sensor[4].

## What is …?

[1]**A Bragg curve:** The peaked energy deposition curve of protons in a medium, e.g. the human body.

[2]**A scintillator:** A transparent material that emits light when it is traversed by ionizing radiation, e.g. protons.

[3]**Quenching:** The fact that not all of the deposited energy in a scintillator is transformed into light.

[4]**A CMOS sensor:** An image sensor which is also widely used in digital cameras.

[5]**A range telescope:** A segmented detector which measures the range of a clinical proton beam.

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